



Attorney Docket No. ASC-023DVC2  
(PATENT)

**IN THE UNITED STATES PATENT AND TRADEMARK OFFICE**

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In re Patent Application of:  
Eugene A. Fitzgerald

Application No. 10/022,689

Filed: December 17, 2001

Art Unit: 2813

Title: CONTROLLING THREADING  
DISLOCATION DENSITIES IN GE ON SI  
USING GRADED GESI LAYERS AND  
PLANARIZATION

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Examiner: Laura Schillinger

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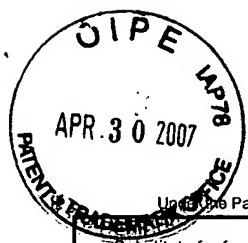
It is respectfully requested that the references listed on the attached Form PTO/SB/08, and other information contained herein, be made of record in this application.

Dated: *April 25, 2007*

Respectfully submitted,

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PTO/SB/08A/B (09-06)

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Substitute for form 1449/PTO				<b>Complete if Known</b>	
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				First Named Inventor	Eugene A. Fitzgerald
				Art Unit	2813
				Examiner Name	Laura Schillinger
Sheet	1	of	3	Attorney Docket Number	ASC-023DVC2

U.S. PATENT DOCUMENTS						
Examiner Initials	Cite No. <sup>1</sup>	Document Number	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear	T <sup>6</sup>
		Number-Kind Code <sup>2</sup> (if known)				
A1	US-4,704,302	11-03-1987	Bruel et al.			
A2	US-5,405,802	04-11-1995	Yamagata et al.			
A3	US-5,426,316	06-20-1995	Mohammad			
A4	US-5,705,421	01-06-1998	Matsushita et al.			

FOREIGN PATENT DOCUMENTS						
Examiner Initials	Cite No. <sup>1</sup>	Foreign Patent Document	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear	T <sup>6</sup>
		Country Code <sup>3</sup> -Number <sup>4</sup> -Kind Code <sup>5</sup> (if known)				

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NON PATENT LITERATURE DOCUMENTS							
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	C1	Batterman, "Hillocks, Pits, and Etch Rate in Germanium Crystals," 28 J. Appl. Physics 11, pp. 1236-1241 (1957).					
	C2	Bohg, "Ethylene Diamine-Pyrocatechol-Water Mixture Shows Etching Anomaly in Boron-Doped Silicon," 118 J. Electrochemical Soc'y 2, pp. 401-402 (1971).					
	C3	Chen et al., "The Band Model and the Etching Mechanism of Silicon in Aqueous KOH," 142 J. Electrochemical Soc'y 1, pp. 170-176 (1995).					
	C4	Desmond et al., "The Effects of Process-Induced Defects on the Chemical Selectivity of Highly Doped Boron Etch Stops in Silicon," 141 J. Electrochemical Soc'y 1, pp. 178-184 (1994).					
	C5	Ehman et al., "Morphology of Etch Pits on Germanium Studied by Optical and Scanning Electron Microscopy," 41 J. Applied Physics 7, pp. 2824-2827 (1970).					
	C6	Feijoo et al., "Etch Stop Barriers in Silicon Produced by Ion Implantation of Electrically Non-Active Species," 139 J. Electrochemical Soc'y 8, pp. 2309-2313 (1992).					
	C7	Finne et al., "A Water-Amine-Complexing Agent System for Etching Silicon," 114 J. Electrochemical Soc'y 9, pp. 965-970 (1967).					
	C8	Fitzgerald, "GeSi/Si Nanostructures," Annual Rev. of Mat. Sci., Vol. 25, pp. 417-454 (1995).					
	C9	Frank, "Orientation-Dependent Dissolution of Germanium," 31 J. Applied Physics 11, pp. 1996-1999 (1960).					
	C10	Ghandi et al., "Chemical Etching of Germanium," 135 J. Electrochemical Soc'y 8, pp. 2053-2054 (1988).					
	C11	Godbey et al., "A Si <sub>0.7</sub> Ge <sub>0.3</sub> strained-layer etch stop for the generation of thin layer undoped silicon," 56 Applied Physics Letters 4, pp. 373-375 (1990).					
	C12	Herzog et al., "X-Ray Investigation of Boron- and Germanium-Doped Silicon Epitaxial Layers," 131 J. Electrochemical Soc'y 12, pp. 2969-2974 (1984).					

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C13	Holmes, "The Orientation Dependence of Etching Effects on Germanium Crystals," 7 Acta Metallurgica 4, pp. 283-290 (1959).
C14	Hunt et al., "Highly Selective Etch Stop by Stress Compensation for Thin-Film BESOI," 1990 IEEE/SOI Tech. Conf., pp.145-146.
C15	Jaccodine, "Use of Modified Free Energy Theorems to Predict Equilibrium Growing and Etching Shapes," 33 J. Appl. Physics 8, pp. 2643-2647 (1962).
C16	Kern, "Chemical Etching of Silicon, Germanium, Gallium, Arsenide, and Gallium Phosphide," RCA Review, Vol. 39, pp. 278-308 (1978).
C17	Klauk et al., "Thermal stability of undoped strained Si channel SiGe heterostructures," American Institute of Physics, pp. 1975-1977 (1996).
C18	Kubota et al. "New SOI CMOS Proess with Selective Oxidation," IEEE IEDM TECH DIG., pp. 814-816 (1986).
C19	König et al., "SiGe HBTs and HFETs," 38 Solid-State Electronics 9, pp. 1595-1602 (1995).
C20	Lang et al., "Bulk Micromachining of Ge for IR Gratings," 6 J. Micromechanics and Microengineering 1, pp. 46-48 (1996).
C21	Leancu et al., "Anisotropic Etching of Germanium," Sensors and Actuators, A46-47, pp. 35-37 (1995).
C22	LeGoues et al., "Relaxation of SiGe thin films grown on Si/SiO <sub>2</sub> substrates," 75 Applied Physics Letters 11, pp. 7240-7246 (1994).
C23	Lehmann et al., "Implanted Carbon: An Effective Etch-Stop in Silicon," 138 J. Electrochemical Soc'y 5, pp. 3-4 (1991).
C24	Ming et al., "Interfacial roughness scaling and strain in lattice mismatched Si <sub>0.4</sub> Ge <sub>0.6</sub> thin films on Si," 67 Applied Physics Letters 5, pp. 629-631 (1995).
C25	Ming et al., "Microscopic structure of interfaces in Si <sub>1-x</sub> Ge <sub>x</sub> /Si heterostructures and superlattices studied by x-ray scattering and fluorescence yield," 47 Physical Review B 24, pp. 373-81 (1993).
C26	Narozny et al., "Si/SiGe Heterojunction Bipolar Transistor with Graded GAP SiGe Base Made by Molecular Beam Epitaxy," 1988 IEEE IEDM, pp. 562-565.
C27	O'Neill et al., "Deep Submicron CMOS Based on Silicon Germanium Technology," 43 IEEE Trans. on Electron Devices 6, pp. 911-918 (1996).
C28	Palik et al., "Ellipsometric Study of the Etch-Stop Mechanism in Heavily Doped Silicon," 132 J. Electrochemical Society 1, pp. 135-141 (1985).
C29	Palik et al., "Study of Bias-Dependent Etching of Si in Aqueous KOH," 134 J. Electrochemical Soc'y 2, pp. 404-409 (1987).
C30	Palik et al., "Study of the Etch-Stop Mechanism in Silicon," 129 J. Electrochemical Soc'y 9, pp.2051-2059 (1982).
C31	Petersen, "Silicon as a Mechanical Material," 70 Proceedings of the IEEE 5, pp. 420-457 (1982).
C32	Powell et al., "New approach to the growth of low dislocation relaxed SiGe material," 64 Applied Physics Letters 14, pp. 1856-1858 (1994).
C33	Rai-Choudhury et al., "Doping of Epitaxial Silicon," J. Crystal Growth, Vol. 7, pp. 361-367 (1970).
C34	Raley et al., "(100) Silicon Etch-Rate Dependence on Boron Concentration in Ethylenediamine-Pyrocatechol-Water Solutions," 131 J. Electrochemical Soc'y 1, pp. 161-171 (1984).
C35	Ransom et al., "Gate-Self-Aligned n-channel and p-channel Germanium MOSFET's," 38 IEEE Trans. on Electron Devices 12, pp. 2695 (1991).

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C36	Seidel et al., "Anisotropic Etching of Crystalline Silicon in Alkaline Solutions," 137 J. Electrochemical Soc'y 11, pp. 3626-3632 (1990).	
C37	Senna et al., "Gallium Doping for Silicon Etch Stop in KOH," Transducers '95/Eurosensors IX, the 8th International Conference on Solid-State Sensors and Actuators and Eurosensors, pp. 194-195 (1995).	
C38	Shang et al., "The Development of an Anisotropic Si Etch Process Selective to Ge <sub>x</sub> Si <sub>1-x</sub> Underlayers," 141 J. Electrochemical Soc'y. 2, pp. 507-510 (1994).	
C39	Soderbarg, "Fabrication of BEStOI-Materials Using Implanted Nitrogen as an Effective Etch Stop Barrier," 1989 IEEE SOS/SOI Technology Conference, pp. 64.	
C40	Sundaram et al., "Electrochemical etching of Silicon by Hydrazine," 140 J. Electrochemical Soc'y 6, pp.1592-1597 (1993).	
C41	Sze, "Physics of Semiconductor Devices," (1991).	
C42	Takagi et al., "On the Universality of Inversion Layer Mobility in Si MOSFET's: Part I-Effects of Substrate Impurity Concentration," 41 IEEE Trans. on Electron Devices 12, pp. 2357-2362 (1994).	
C43	Vol'fson et al., "Fundamental Absorption Edge of Silicon Heavily Doped with Donor or Acceptor Impurities," 1 Soviet Physics Semiconductors 3, pp. 327-332 (1967).	
C44	Vossen et al. "Thin Film Processes II" Academic Press Inc., San Diego, CA 1991, pp. 370-442.	
C45	Wu, "Novel Etch-Stop Materials for Silicon Micromachining," Thesis Submitted to the Massachusetts Institute of Technology Department of Materials Science and Engineering on May 9, 1997, pp. 1-62.	
C46	Yi et al., "Si <sub>1-x</sub> Ge <sub>x</sub> /Si Multiple Quantum Well Wires Fabricated Using Selective Etching," 379 Mat. Res. Soc. Symp. Proc., pp. 91-96 (1995).	

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